Earth Science®

DIGEST

Mr. A. Hutton Vignoles, of Upper Newton Falls, Massachusetts, putting the finishing touches on a scale model of America's first successful blast furnace. (See "Cradle of America Industry," page 7.)

35¢

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CONTENTS, NOVEMBER-DECEMBER, 1954 Vol. 7, No. 9

EDITOR'S MEMO PAD

With conventions over and vacations drawing to a close, most rockhounds are now settling down to a season of winter activities. There will be the monthly club meetings to attend, with occasional directors or committee meetings in between, to say nothing of parties and field trips. Many will retire to basement work shops to take up lapidary pursuits, or they may even do silversmithing. Other will attempt to catch up on their reading, or to study, while some may add to their collections by purchase or exchange.

Let us remember, however, that we get out of our hobby no more than we put into it. In every club there are always the workers and the drones. On the one hand are those who take responsibility and do the planning and organizing so necessary for conducting a successful society. On the other hand are those who only attend and absorb, contributing as little as the law will allow to the common welfare. Of course there are, too, the in-betweens, who respond when called upon, but like to hide behind those sitting in front of them when the officers are looking for volunteers to take on some job or to work on some committee.

To which class do you belong? Let's take stock of ourselves! Why not get in and pitch.

The success of an Earth Science Club, like any other organization, depends largely upon long range planning, and one thing which every club should begin doing at once is planning for active participation in their next year's Regional Federation Convention. Every single club in any Federation should be represented by delegated members to participate and vote in the annual business meeting, and in addition by as many other visitors as can possibly attend. Those who attend conventions regularly get the biggest thrill and most benefit from their avocation.

Each club also should have an exhibit, be it large or small. Few realize how disappointing it is to those who work hard and plan to make a successful convention, when there is a poor response from club exhibitors. Start making plans for your convention exhibit now, so we'll be admiring it at Detroit in 1955. Same goes for the clubs of other regional conventions throughout the country. Let's get busy!

Authors

JAMES O. MONTAGUE, is an example to all for for ability, industry and co-operation in the field of earth science. He is honorary curator of geology of the Milwaukee Public Museum and was chairman of the successful 1954 Midwest convention at Milwaukee. MRS. JUNE CULP ZEITNER and her husband, of South Dakota, make a team illustrative of the family aspect of our earth science pursuits. (In what other hobby can whole families join as in ours, indoors and out, at home and afield!) GUY E. HAZEN writes from Kingman, Arizona. FRANK L. FLEENER, who writes from Joliet, Illinois, is remembered by our readers for his series on the history of coal.

*

Cover

The gentleman pictured in connection with our story of the Saugus ironworks restoration, seems to be taking great delight, as do thousands of hobbyists, in scale model making.

—BEN HUR WILSON, *Editor*

EDELSTEINE UND PERLEN — Prof. Dr. Karl Schlossmacher. Schweizerbart-sche Verlagsbuchhandlung, Germany, 1954.

This book by the eminent German gemologist, Dr. Schlossmacher, is the latest work on the general subject of gems and gemology to come out of Germany. It is a major classic work and is brought completely up to date. It is a book well written and easy to read for those who have a reading knowledge of German. It it particularly well illustrated and contains a great deal of information not found in any other gem book.

This book is intended not only for gemologists and other gem experts, but for researchers, teachers of general courses in minerals, gems, gem appreciation, etc. The material is eminently practical and the jeweler and the general gem lover will find much that he has looked for and not found before.

There are many reference tables and there is an excellent index which researchers will find valuable.

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Saugus, Cradle of American Industry

by BEN HUR WILSON

THREE CENTURIES AGO a group of industrious colonists established America's first successful ironworks at Saugus, Massachusetts. The ironworks was a sizeable operation providing hundreds of tons of bar iron from which blacksmiths made many of the axes, saws and other tools so vitally needed to build a new country.

To finance the ironworks a company was organized in England known as the "Company of Undertakers for the Iron Workes in New England." Investors included merchants, lawyers, brewers, civil servants, tailors, a physician and several clergymen. A bold capitalistic enterprise, the company probably was the first of its kind in the American colonies.

Earlier iron-making attempts at Falling Creek, Virginia, and at Braintree, Massachusetts, had failed to produce and market iron. It is from this industrial root by the Saugus River, buried deep in the American past, that the steel industry has grown until it is capable of producing over a hundred million tons of steel a year.

Hammersmith was the name the group of English capitalists gave to their new settlement on the bank of the Saugus River in Massachusetts Bay Colony, ten miles north of Boston. Often called "The Cradle of American Industry," the Hammersmith works draws signficance from the fact that it was the first in the colonies to produce successfully both cast iron and wrought iron from pig iron.

Besides making a new grade of iron, the early Saugus plant provided a training ground for ironmasters who later built other plants throughout the colonies. Its productive life extended from about 1646 to about 1675. Plagued with financial and other difficulties, the Saugus ironworks was abandoned about 1675 and fell to ruins.

Five years ago the "First Iron Works Association, Inc.," with the financial support of American Iron and Steel Institute, began restoring the Saugus Ironworks. When completed, the Saugus Restoration will become at once a shrine to the pioneer capitalists, managers and workers of colonial days, and a monument to the men of industry in later generations who helped develop the American economy in a climate of freedom.

The ironworks venture was the first large-scale corporate industrial enterprise in America. Backed by private capital, run by men in search of profit through supplying a genuine need of the public it served, it was in many aspects the prototype of modern industrial America.

At Hammersmith upwards of a hundred men toiled to make pots and pans, nails, bolts, chisels, mattocks and other implements needed in the daily life of the colonists of New England.

These men dug ore from nearby bogs, then melted and refined it into iron. Some they poured in molds for cast ware. Most went into the forges as pigs, to be oxidized into wrought iron which was then hammered out into the shapes they wanted. In good times they turned out a ton of iron a day, for the use of pioneers who had a continent to conquer.

Relics of their handiwork have outlasted

the three centuries since "char-coal" fires blazed hot in the blast furnace and giant hammers rang on the anvils. Something has remained of the slag pile, too; and the Ironmaster's House, on a bluff above the ironworks, stands on its original foundation. But earth had covered over most of the ironworks site in the long generations since the 1640's, grass and other greenery had mantled it, and it seemed that America had little memory of this cradle of its industry by the Saugus River.

In backwaters of history lay a wealth of records bearing on the ironworks—letters written with a quill in quaint seventeenth century script; orders and decisions of the General Court of the Massachusetts Bay Colony; fragments, teasing references to documents that no longer exist. A busy historian, in quest of the career of a great man or of a disputed event, might occasionally toss up some of this flotsam, but like the forge and the waterwheel, it was mostly ignored for matters more pressing.

A scale model of America's first successful ironworks now being reconstructed as a national shrine at Saugus, Massachusetts.

Yet, through the years legends had persisted, tales told to children at some New England grandfather's knee, repeated by word of mouth and sometimes written down, though only half-believed, by a diligent local historian.

Unseen under the ground, not six inches down, lay the 505-pound hammer head from the forge, near the buried oak stump that had been the anvil's base. Hard by, a 200-pound crude iron "sow" was encircled by the roots of an elm. Even the location of the giant foundation of the blast furnace was unknown. A child might find on the Saugus River bank a curious, rusty piece of iron that looked something like a spike, just as he might pick up a flint arrowhead—and toss both aside when he had played with them. A busy street ran over the beautifully-joined waterwheel, perhaps the oldest extant in America.

It was the antiquarian interest of the late Wallace Nutting, distinguished artist and photographer of New England scenes, that brought a flush of new life into the ancient ironworks site. Mr. Nutting restored the Ironmaster's House and for a time used it as a museum of colonial handicrafts.

In 1942, as *Steelways Magazine* relates, "graduates of the Ford Trade School bought the old Ironmaster's House, still standing on the site, for $12,000. They proposed to move it to Michigan, a thousand miles away, as a gift to Henry Ford for his collection of early houses at Dearborn Village.

"And then in the office of the town assessors, where Sauguas property transactions are scanned, the celebrated New England conscience spoke to one of the clerks. Miss M. Louise Hawkes was aware that her

ancestor, Adam Hawkes, had lived nearby in 1630. She knew the story of the ironworks, and she was determined that what belonged to Saugus should remain in Saugus. But the thought of raising $12,000 to save the old building?—that was impractical, fantastic. Besides, the sale had been made, the deed delivered.

"So Miss Hawkes proceeded to perform the impractical and fantastic. She aroused the town of Saugus and the State of Massachusetts. With the intervention of Governor Saltonstall and Mr. Ford's cooperation, the structure was saved for New England. A chain reaction had been set up. The First Ironworks Association, formed in 1943, carried on the work of focusing public attention on the site."

With the old house restored and the First Ironworks Association active and interested, attention quickly turned to the reason for the existence of the Ironmaster's House, the ironworks itself. Arrangements were made for preliminary explorations and excavations. Taking rough directions from the blast furnace cinder pile, an archeologist soon found the actual furnace foundations and bellows base timber evidence.

During the succeeding years, through further careful exploration and the meticulous research of expert historians and antiquarians, much progress has been made in the actual restoration of the famous and noteworthy ruins. A visit to the site of "The Saugus Restoration" should now be a must in the experience of every rockhound and student of American History, traveling or visiting throughout Old New England.

(A most delightful illustrated booklet, telling the complete story of "The Saugus Restoration," may be had for 25c from the First Iron Works Association, Saugus, Massachusetts, from which much of the foregoing article has been quoted, by permission.)

Chalcedony in the Bad Lands

by JUNE CULP ZEITNER

ONE OF THE MOST INTERESTING minerals to my husband Albert and me is chalcedony. We have found weird chalcedony formations in the deserts of the southwest, we have picked up gayly colored chalcedony geodes from the shores of Tampa Bay, we have dug for botryoided chalcedony over jasper in Texas, but by far the biggest chalcedony deposits we have seen are in our own state, South Dakota.

Not far from the Bad Lands town of Scenic on a side road is a so-called town by the railroad track called Imlay. Here we gazed upon hundreds of acres veined and encrusted with chalcedony.

Some of the chalcedony is gemmy material for the lapidary. The best shows carnelian color and some shows montone banding. Often huge sheets of the material several feet long may be picked up unbroken. There is more often than not a chalcedony "sandwich," a layer of more or less thick and smooth chalcedony on the top and bottom with a spongy layer of crystals and/or such growths as stalactites and stalagmites in between.

In some places the chalcedony of one butte will blend in with the soil of that butte. If the butte is black the chalcedony may be dark grey or if the soil is red the chalcedony will be of palest pink.

One of the most interesting forms to look for is the chalcedony replacements of cracks in the earth. In many spots the hard baked gumbo has every crack cemented with chalcedony. If a little rock was in the way the chalcedony covered the rock.

Not far to the south and almost in direct line with the area is a well known fossil locality near Crawford, Nebraska extending into South Dakota, where bones of many prehistoric animals have been replaced by chalcedony. The most sought for

specimens in the South Dakota area are the chalcedony geodes. Here is the place the amateur mineralogist can most nearly understand the how and why of geodes.

The Bad Land clays themselves are tough and resistant but the chalcedony more so. Where there were cavities in the clay instead of cracks the chalcedony was deposited in solution forming hollow balls—or geodes. These geodes are usually lined with a secondary crystal growth of quartz or selenite. Often the interiors have a pale pink or lavender tint. The sparkling and delicate bladed selenite crystal inclusions are rarest.

Like the vein chalcedony, the geodes proclaim their home. On one light colored hill all the geodes we found were lined with nest milk white quartz crystals and the exterior of these was like frosted glass. Another red clay butte produced nearly a basket full of bright pink geodes.

In size the geodes vary from almost microscopic to about the size of a basketball. Large ones are extremely rare. C. C. O'Hara in his book "The White River Bad Lands," claims the largest are the size of a baseball. But since my husband found one the size of a basketball, we know they can be obtained that large. The average is about 2" in diameter.

I have one of these geodes which includes dolomite and another which has small white cubic crystals which I cannot identify. Other than that inclusions are rare. Never have we found water in them as we have in geodes from other areas. Nor has oil been reported in them as from those of the Warsaw formation.

Many of the geodes as in other areas are completely filled in with interlocking crystals. These are hard to break. The really good ones have so thin a wall that they shatter readily. The best way to open one of a good size and color, and light in weight, is to use the diamond saw.

The chalcedony veins of the Bad Lands have been known since the late 1800's and much fossil hunting has been done in the area by eastern universities since 1910.

One of the most unusual specimens we have is an odd shaped hunk of chalcedony which follows the pattern of the earth's wide cracks where we found it, and in several places where the cracks are wider small geodes are trapped.

There are undoubtedly geodes buried in the clays which will weather out as the softer clays are worn away—but the strange thing is that digging does not reveal any geodes. Another odd thing is that higher levels often reveal very tiny geodes while larger ones are often found around the bottom of the buttes.

Collecting is allowed at most locations if permission is asked. However, many children in the area pick up specimens to sell to tourists at reasonable prices.

The only collecting hazard in the locality is rattlesnakes.

Although this whole area is mainly known for its conspicuous chalcedony deposits, other minerals of the quartz family are also found. Black agates west of Scenic, "fish egg" agates east of Scenic, and various kinds of jasper and petrified wood are scattered over many square miles.

THE MISSION CURIO MART, Tucson, Arizona, will be open again this winter, and visitors may admire the fine display in the building constructed for it.

The Mart was closed last summer, following the death of Mr. David Palmer Record, who had been associated in the business with his mother, Mrs. Claude L. Motel.

"Silurian Trilobites," by James O. Montague, page 11.

(References: "The Trilobita," by Stewart Weller; "The Paleontology of the Niagaran Limestone in the Chicago Area" — Chicago Academy of Sciences. "Historical Geology," by Raymond C. Moore—McGraw-Hill Book Company, Inc. "Index Fossils of North America," by Schimer and Schrock—John Wiley & Sons, Inc. "An Introduction to Geology," by William Berryman Scott—Macmillan Company.)

Silurian Trilobites

by JAMES O. MONTAGUE

THE SILURIAN PERIOD was the shortest, 27 million years, of the Paleozoic Era. The emergence of land which divided the Ordovician from the Silurian was gradual and with a minimum of disturbance, with the exception of some volcanic action in the eastern part of the United States. There was also some folding and faulting known as the Taconic disturbance at the close of the Ordovician.

The area was not as extensive as in the Ordovician when the land submerged and the shallow Silurian seas rolled in. Silurian outcrops appear in Eastern and Northern parts of the American Continent: New York, Ontario, Upper Peninsula of Michigan, Wisconsin, Illinois, Indiana and Ohio. In the Appalachian region narrow outcrops appear, from New York to Alabama. In addition to these beds outcrops are known in Arkansas, Oklahoma, Missouri and Iowa.

The sub-tropical climate changed very little during the entire period. This was favorable to an expansive growth. However, the trilobite had reached its culmination and entered the Silurian with a great decrease in numbers. According to Moore the genera was reduced by half (99 to 47) and the number of species from 390 to 180. There was also a decided change in some to a very conservative form, while others were highly specialized.

The Silurian exposures of the Midwest, particularly the Chicago and Milwaukee areas, contain the fossil remains of a number of genera and species of trilobites. The following descriptions are mostly from specimens in these areas:

Bumastus ioxis, Hall, is widespread throughout Eastern and Central North America. It is the most abundant species at Racine, Wisconsin. There must have been moulting places in this area, as large sections of rock contain great portions of tests, one upon the other consisting of glabellas and pygidiums, but never complete specimens. However, often complete cephalons, which may have a thoracic segment attached, also are found. These are always found at some distance from a moulting area.

The cephalon is composed of four parts: glabella, two free cheeks and hypostome (under lip). We have one from Racine that measures 95mm in width, 66 mm in length, and 78 mm between the eyes. The glabella is convex and wider at front than at back; there are extensions over the eye lobes which are located on the free cheeks.

Bumastus imperator, Hall, is the largest in this genera and is common to the Burlington, Wisconsin, area. Bumastus insignis, Hall; B. triloba, N. Sp; B. coniculus, Hall; B. niagarensis, Whitfield, are all found in the Lemont, Illinois, area.

This genera is lacking in ornamentation. Both the cephalon and pygidium are smooth and the thorax segments lay evenly over each other.

Calymene celebra, Raymond, is commonly mis-named niagarensis. This is the little fellow so much sought after to make into pendants and pins. It is also used as a mold to cast sterling silver cuff links, etc. Fortunately it is one species that is found complete. Lemont, Illinois, and Milwaukee, Wisconsin, have been favorite collecting areas. The Lemont quarry is closed and the Milwaukee quarry is close to its boundry lines and will soon be on the closed list.

Ceratocephala goniata, Warder, is somewhat ornate, having four cheek spines that extend outward and upward. It is found in Ohio, Illinois and Wisconsin. A specimen was found in the Hartung, Quarry, Milwaukee, a short time ago.

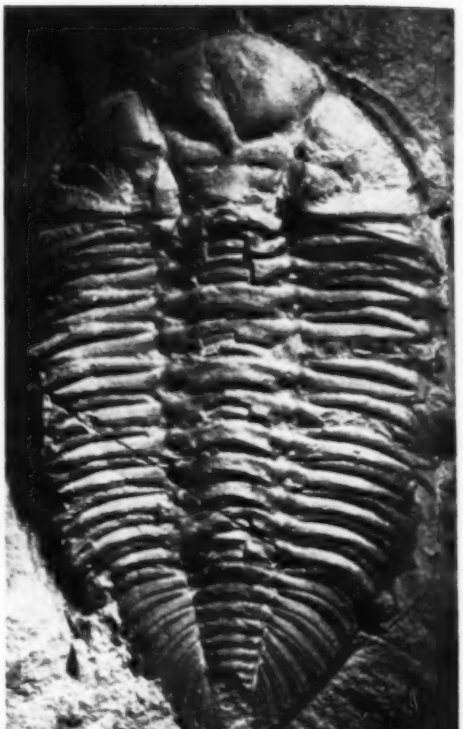
Ceraurus hydei, N. Sp.; Cephalon semicircular in outline with slender genal spines extending backward to the third thoracic segment; glabella extends almost to rim of cephalon; eleven thoracic segments with

short spines at ends; pygidium is very short with two backwardly pointing spines. Found near Lemont, Illinois, and Milwaukee, Wisconsin.

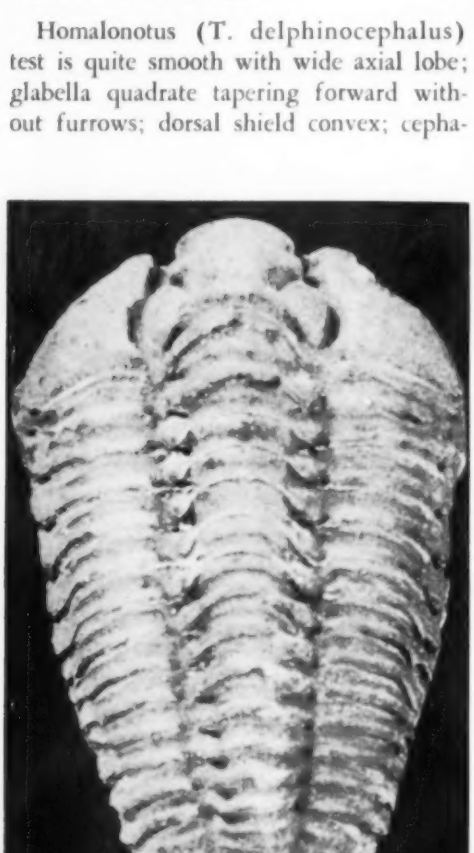
Dalmanites imulutus lunatus, Lambert; semi-circular cephalon with frontal glabella lobe extending to rim; three pairs glabella furrows; short genal spines; axial furrows deep; eleven to thirteen thoracic segments; pygidium triangular with point on posterior end; ten to eleven annulations. Found in New York and Wisconsin.

Other Silurian Dalmanites are D. halli, Weller; D. verucosus, Hall; and D. viligens, Hall. All are to be found in Indiana, Illinois and Wisconsin.

Homalonotus (T. delphinocephalus) test is quite smooth with wide axial lobe; glabella quadrate tapering forward without furrows; dorsal shield convex; cephalon depressed in front; pygidium triangular with twelve annulations. Found in Ontario, New York, Indiana and Kentucky.



Dalmanites imulutus lunatus, Lambert. (Lockport, New York.)



Silurian Trilobite. Calymene celebra, Hall. (Hartung quarry, Milwaukee, Wisconsin.)

All Midwest rockhounds have a wonderful opportunity to study Silurian trilobites and other fossils. The Chicago and Milwaukee areas have been very productive of specimens. Now it is a changing scene. Many of the old quarries have been abandoned and are now filled with water. Present day methods of operation keep the quarries quite clean at all times and the collector must be on the spot shortly after a shot has been made to secure good material. All collectors should report their finds to their societies and museums in their territory. There is a great possibility of finding a new species.

Sandstone Concretions of the Colorado Delta

by GUY E. HAZEN

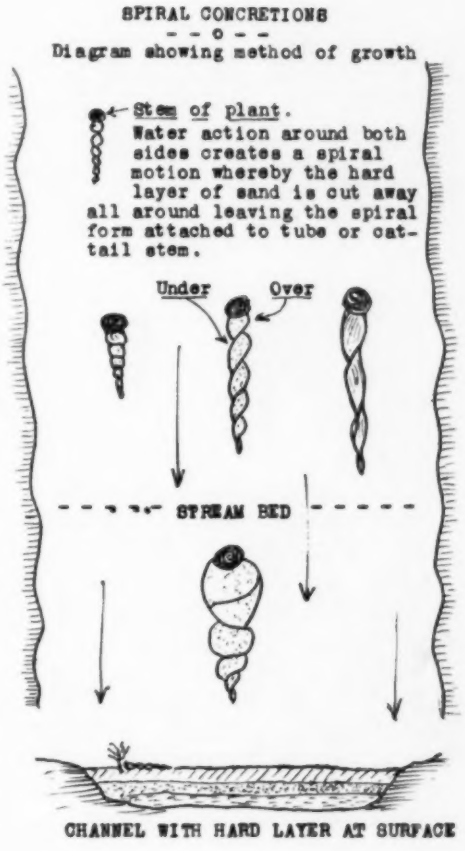
IN THE BROAD EXPANSE of land just east of the Coast Range in San Diego County, California, lies Imperial Valley, extending from Coachella Valley in the north and southward into Mexico. The valley has a width of up to 60 miles. These valleys have been created by faulting along the line of the San Andreas Rift which extends throughout the valleys and on into the Gulf of California in Mexico.

The present land surface of Imperial Valley and part of the Coachella valleys is part of the Colorado River Delta region. Today the delta is forming in the northern end of the Gulf of California. The central portion of the valley lies below sea level and the lowest part is occupied by the Salton Sea. Much of the central valley is under irrigation, the soil having been laid down in fairly recent times by the Colorado river.

From time to time the Colorado river changed its channels, thereby causing the water from the river to flow first one way then another. One of the last shifts of channel was to the north where it formed a body of water known as Lake Coachella. The old shore line may be seen at many places, one of which is at Travertone Point along U.S. 99—some 22 miles south of Indio, California, the highest mark being sea level. This was before the advent of the white man; there are signs that Indians were living there while the lake was filled to its highest point.

The last time the river flowed north was in 1905. The river broke through the dikes of the Southern Pacific Railroad along the Colorado River near Yuma, flowed northward through Imperial Valley and flooded the sink. Later the Colorado river changed its course and flowed direct into the Gulf of California. The flow of the Colorado River continued to run into the gulf for a long enough period that the Coachella dried up, leaving a dry bed from which salt was taken, making what is now known as the Salton Sea.

Land movements along the San Andreas Fault during Pleistocene times have raised much of the west side delta deposits upward, so that much of it today is above sea level. Much erosion since the uplift has cut into the delta deposits, exposing the various strata to view. These are known as the bad lands, which are mostly composed of silts and clays deposited in deep water, and stream-washed sands and gravels deposited adjacent to or above deep water, most of which were from the Colorado River.



According to Fay in the "Dictionary of Geological Terms" a concretion is a spheroidal or discoidal aggregate formed by the segregation and precipitation of some soluble mineral like quartz or calcite around a nucleus which is often a fossil.

This definition while true for most concretions, is not true in all cases. The various forms of sand crystals will have the form of the crystal shape of the mineral which was precipitated. This is generally a hexagonal like calcite, from which most sand crystals are formed. Another form is that of barite.

As this article is mostly about the spiral concretions, the various general forms will not be discussed except in relation to the shape of the spiral and sand spike concretions.

On the west side lying adjacent to the Coast Range are the uplifted sediments of the Colorado Delta deposits, which were mostly formed in late Pleistocene time. These are composed of clays and sands, the red clays representing a deposit in water of depths where only the fine particles were carried out by the river current. The sands and gravels represent land or shallow water deposits.

As the spiral and other sand concretions occur in the sands this formation will be discussed in relation to the forming of the concretions. These sands are composed in most part of the rock material derived from the land area which the Colorado River and its tributaries drain, except those deposits close to the Coast Range, which are of local nature.

Recent aluviums cover much of the area, so that only the higher portions have the Pleistocene deposits exposed. These exposures lie mostly in valleys extending into the Coast Range or close to the ends of the extending ridges. The extent along the Coast Range reaches from below the border of Mexico and up to the end of the Santa Rosa Mountains, a distance of 70 to 100 miles.

There is an exposure on the east side of the Salton Sea and some clays and sand of the river among the upturned sediments on the north side of Coachella Valley. As the type of concretion to be described occurs only in gravels brought down by the river it is there that the delta deposits will be discussed.

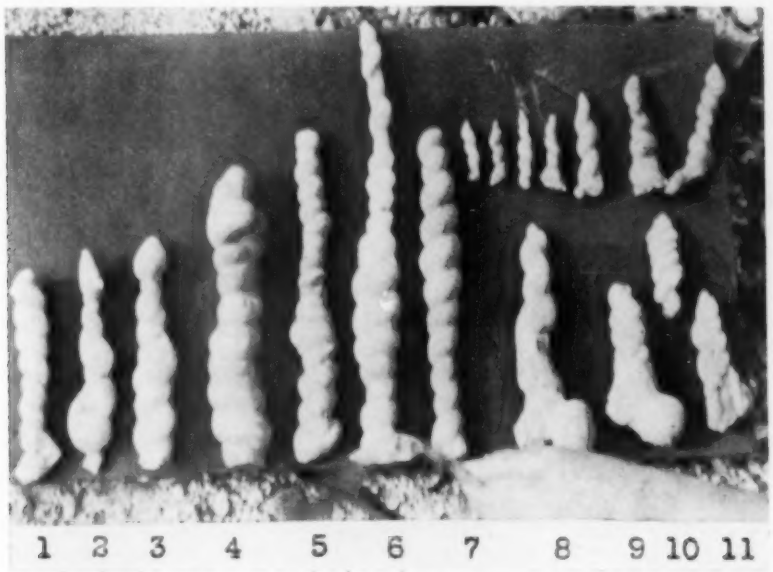
At the time the delta was being formed, the waters of the Colorado River were probably being split into diverse channels, which would shift more or less periodically, but leave exposed portions only a few inches above the water level of the newer channels. These channel beds consisted of various gravels and clays which were carried down into the basin. A certain amount of water would rise by capillary action from the ground water to the surface of the exposed channel sands, where it was then evaporated by the winds and the sun. In consequence of this evaporation of water, there was formed close to the surface a deposit of mineral salts which consisted mostly of calcium carbonate, thereby forming a hard, firm crust on the surface, of a few inches in thickness.

Owing to obstructions being built in the channels at times adjacent to this area, the waters overflowed thinly over these marginal land channels, gradually eroding and causing small channels to be cut through this hard surface at numerous places, and gradually carrying away the accumulated hard top layer until there were small strips and patches left in line with the stream flow. These were then carved further into various streamlined shapes, some of which were long tapering spikes, with a rounded head on the upstream side, tapering down to a point in a symmetrical form. These today are found in the exposed sediments and are called Sand Spikes. Another type which was formed by a slightly different method—formed just below a stem or plant growth of some kind which grew out of the sands. Action of the water rushing around this obstruction set up a spiral motion, thereby fashioning a spiral-like, tapering sand projection back of the plant stem. These were sometimes right-hand, or left-hand twists, or at other times, not be-

ing a complete spiral form, resembled a braided form, because the water action apparently did not get underneath and make a complete spiral action. There are various other shapes which, because of slightly different conditions, would make different forms from those mentioned. However, all concretionary forms found in valleys are not necessarily fashioned by this method.

Before these remnants of the former hard layer were completely eroded away, deposition evidently started to take place, covering up the various forms cut out by the water, and burying them to considerable depth in other clays and gravels of the Colorado River.

It was possibly during the late Pleistocene epoch that the mountains on the west side of the valley were raised to some undetermined elevation above their former height and the portion of delta sediments adjacent to them also raised above their former position. Land surface erosion then began, and proceeded into the present day, exposing various strata of the underlying delta deposits of sandstone clays, etc. This erosion laid bare the former, eroded-out figures which were shaped by the delta channel waters and which, having a greater resistance to the erosion, are left exposed among the canyons and hills of the present day bad lands of western Imperial, Borrego and Coachella Valleys. The sand spike form has also been found above Davis Dam in the river sand terrace of the Colorado River.



Numbers 1, 2, and 4 are left-hand twists as are several of those in the right-hand corner. Nos. 1, 2, 3, 5, 6, and 7 are complete with both terminations. No. 8 is a spiral with a different knob of sandstone on the lower right side. This is a finer grade of sandstone which formed as a concretion outside the area and then carried in and deposited before the others were formed. Nos. 9, 10, and 11 are the double spirals, one left and two right-hand twists.

Some concretions are formed by crystallization of calcium carbonates within the sand in a radiating aggregate. The sand spikes had more added to them by a calcium carbonate crystallation after burial, by precipitation of a solution passing through the strata in which they occurred. This gave the knobby form to those along the Mexican Border and above Davis Dam, Nevada.

When found these sand spikes and

spirals are all pointed in the direction in which the water flowed in the channels. There is a crystaline type of concretion like sand crystals formed in various shapes within the sands of the Old Colorado River channels.

Sand spikes are also found close to the Mexican border near Signal Peak, west of El Centro, and the spiral concretions are found in the exposed sediments at the lower end of the Santa Rosa Mountains just west of the Salton Sea.

It is not possible to see any of the sand spikes or spiral concretions in place any more, as collectors have carried all away. However, many other forms of concretions can be seen throughout the bad lands. The accompanying drawings will try to convey the process whereby the various concretions were formed just before burial. The map will show the general location of certain types of concretions of interest. Not all of these locations on the maps can be reached by cars with two wheel drive.

As erosion continues, more concretions will be exposed, but it will be hard to dig them out, as they mostly have the surrounding sand adhering to them, so that one cannot get a good specimen.

These and most of the concretions only occur in the sands brought in by the Colorado River. Some of these sands are as far north as Indio, but not many of the well formed and smooth shaped concretions occur there, or in the Box Canyon area.

The following areas have well formed concretions in them: The Mexican border, Superstitious Mountain, Carrizzo Creek, Fish Creek, lower Borrego Valley, 17 Palms, and Palm Wash area.

Water now covers much of the area above Davis Dam where sand spikes were found. Many of the spikes from this area can be seen at Anna Parks' Museum on the north side of the Boulder Dam Highway, just on the edge of Las Vegas, Nevada.

Concretions show the stratification of the sand in a lengthwise direction. A crystalline type of round concretion occurs in the same strata as the spiral concretion, but the sand is finer and darker, having been formed previous to the spirals and carried into and buried with the others.

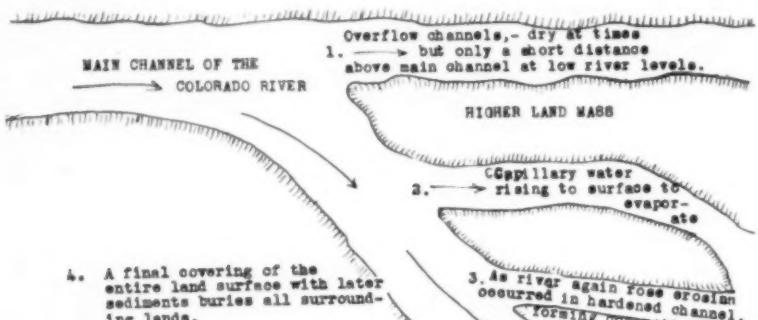


DIAGRAM SHOWING STAGES OF CONCRETION GROWTH

(References: *American Journal of Science*, April, 1936; *Desert Magazine*, July, 1949; *Nature Magazine*, February, 1938.)

Pictures from your rock hunting expeditions, and any nature subjects, may be entered in the 10th Chicago International Nature Photography Exhibition, to be held at the Chicago Natural History Museum in February, 1955. Geological subjects are especially welcome, but there are also classes for plants and animals. There are two divisions, one for prints and one for color slides. Silver medals and ribbons are awards in each classification. Deadline is January 15, 1955. Write to Eugene Stitz, 4754 N. Karlov, Chicago 30, Illinois, for entry form.

Discovery and Development of Lithography

by FRANK L. FLEENER

WRITERS HAVE OFTEN COMMENTED upon the fact that so many of the great discoveries which have contributed materially to the progress of civilization have come about through accident. Few of these commentators have made mention of the element of necessity that is so often present and adds a zest to the situation. Many instances could be cited which bear out the old saying, "Necessity is the Mother of Invention," but we will content ourselves with the story of the discovery of Lithography which is a fair but little-known example.

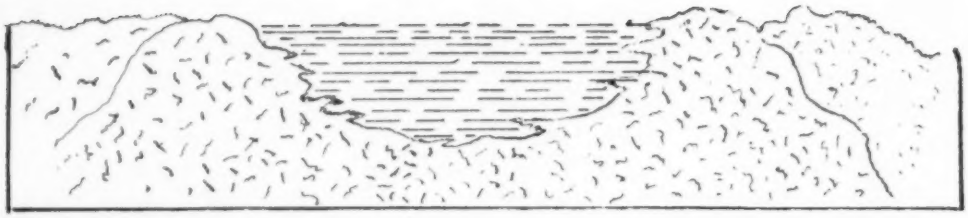
Alois Senefelder, the discoverer of this useful art, was born in Munich, Germany, Nov. 6, 1771. His father was an actor of sorts, who somehow was able to provide amply for his wife and son but never succeeded in laying aside anything for an eventuality. The father died while Alois was still in law school; consequently he was compelled to give up his studies and return home, in order to earn a living for himself and his mother.

Alois was so amazed at the unexpected turn of affairs that he did not know which way to turn to amend his condition. An attempt to follow his father's profession met with dismal failure. He then turned his hand to playwriting, with some success, but was greatly handicapped by the difficulty of publishing his compositions. In his attempt to solve this problem, he purchased a small printing press, but being unable to pay for the engraving of the plates necessary to print his works, he set out to do the engraving himself. In this he also met with little success, since both tools and skill were wanting. Furthermore, the copper plates were expensive and Alois was too poor to buy enough of them to print a complete edition, so he was compelled to resurface plates that had been used before. All this was so tedious and took so much time that he was about to give up in despair, when suddenly his attention was called to a possible solution of his difficulties.

Many years afterwards he told the following story. A short time before this Alois had purchased a small slab of Solnhofen stone primarily to use as a mortar upon which to grind and mix his ink, but the ease with which the stone could be resurfaced made it an admirable medium upon which to practice engraving backwards, an art necessary to properly engrave the plates. On one occasion while working on his practice exercises, his mother came to him and asked him to write a bill for the washer woman. No paper being at hand, Alois wrote the bill upon the stone upon which he was practicing, using as ink a mixture of beeswax, soap, lampblack and water. This mixture he had been using to cover mistakes on his copper plates.

As Alois stood looking at the dried writing on the stone, it suddenly struck him that the same ink might offer sufficient resistance to acid and that, perhaps, the letters might be brought into sufficient relief by etching and thus be used in the same way as wood blocks for printing. Alois was so desperate that he was willing to try anything that offered a possibility of helping him solve his problems. So he set to work, the stone was etched with acid, inked, and an impression was made, the results filled him with great joy. A way out of his printing difficulty had miraculously been found. This occurred in 1798 or 1799, historians are not agreed on the exact date, and was the beginning of the art of Lithography.

Senefelder was so overjoyed at the sudden change in his affairs that he gathered up all the copper plates and went out and sold them, and with the proceeds brought more Solnhofen stone, and a bottle of wine



Idealistic diagram of an atoll with shallow lagoon as it may have existed in the Solnhofen-Eichstadt area in Bavaria.

for a little celebration with his mother. Alois continued to experiment with his new-found art and in many ways succeeded in improving the new method of printing. One of the greatest advances in the art of lithography came about when an unetched stone was inadvertently placed in the press. Quite contrary to expectation, the print thus made appeared as good in all points as those made on etched stones. Thus it was found out that if the ink containing soap or grease were used to make the writing or drawing on the stone, it was not necessary to etch the design into high relief, providing the stone was kept damp during the process of inking. This surprising discovery is based on the repugnance of grease and water for each other. Aside from the application and improvement of certain mechanical devices to expedite the carrying out of this fundamental principal, there has been little progress made in the art from the time of its inception to the present day. We are pleased to note that the king of Bavaria recognized the importance of the invention and rewarded Senefelder with a generous pension, which gave him freedom from want in his old age. He died in 1834, having lived to see his invention brought to a comparatively high stage of perfection and in use in both Europe and America.

The Solnhofen lithographic stone that played such an important part in all this, is unique among the limestones. It is exceptionally homogeneous, amorphous rock, with a very fine grain. When dry, its hardness is about three in Moh's scale, which is neither too hard nor too soft for engraving purposes. The stone is also very low in impurities of any kind that would interfere with the uniform working of the stone. In this latter respect the Solnhofen stone is exceptional.

For nearly a century after the discovery of the art of lithography, almost all of the stone used for this purpose came from the vicinity of Solnhofen, Bavaria. While a great number of different kinds of stone were experimented with, none of them responded to the process like this one stone.

The beds are of Jurassic age and their origin presents a most interesting problem in sedimentation. The formation is composed of 75 feet of beds, two to six inches in thickness with occasional partings of a grayish clay between the beds. Briefly, the geologic history as it has been interpreted by analogy may be summed up thus. In late Jurassic time the continent of Europe was eroded down close to sea level, resembling an archipelago, such as now exists in the South Pacific and having similar tropical climatic conditions. Fringing coral reefs and atolls were scattered about among the islands.

In the Solnhofen-Eichstadt area an atoll with a shallow lagoon existed, probably somewhat submerged at high tide but becoming a mud flat at low tide. The water within the lagoon was calm, and hosts of denitrifying bacteria produced a steady settling of a limy ooze, which were eventually consolidated into the lithographic limestone beds. Comparable situations have been investigated in the South Pacific in modern times.

The Thunder-Egg and I

There is something about a thunder-egg that I don't like and I don't know exactly what it is. I can't honestly say that any thunder-egg ever did anything to me to make me dislike the things. For that matter, I don't remember any doing anything to make me like them either. I guess that is what I don't like about them—they don't do anything but be a thunder-egg. Their general attitude is one of aloofness and disdain. A sort of "I was born a couple of million years ago. And you?"

I don't know who gave me my first good sized thunder-egg and thereby upset the tranquility of my rational existence for a considerable length of time. Perhaps it is as well. I have tried to forgive and forget and have done fairly well in the forgiving department but I cannot forget. There always remains the deep, dark suspicion that whoever did it, did it on purpose.

My thunder-egg was a very good one, as thunder-eggs go. It was fairly round and about five inches in diameter and looked very much like something that occasionally comes out of my furnace. I was delighted with my treasure. It was my nut and it was up to me to saw it. I was an 8" diamond saw enthusiast at the time and spent most of my spare time sawing little dornicks up into littler ones and the problem

"Sawing little dornicks into littler ones."

didn't appear to me to be complicated. My thunder-egg was 5" in diameter. My saw, 8" in diameter. I would saw as far as possible, turn the thunder-egg around and finish the cut. It was just as simple as that. I had a lot to learn about thunder-eggs it seems.

Picking a peaceful summer evening for the big event and with visions of a beautiful amethyst center in my thunder-egg I fastened it to my little saw table with a complex arrangement of "C" clamps and started the motor. Everything worked out beautifully and the saw blade rapidly cut into my treasure. And then it happened. I must have hit a knot or a nail, or something. A penetrating shriek developed and

the whole saw assembly vibrated like a model "T" Ford in its last stages. Concurrently interrogatory remarks were aimed down the basement stairs from the upper regions presided over by my normally patient and understanding wife. It was apparent that this unholy racket was rapidly becoming too much for her usually sunny nature.

I explained that I was only sawing my thunder-egg and that any auditory disturbance was a normal sequence of said operation and could be interpreted as a first class indication that the saw was doing its stuff. She replied that she didn't understand what that was all about but, whatever a thunder-egg was, I should, in all fairness to it and the community at large kill it first. The neighbors might get the wrong idea.

Discouraged, I turned off my saw. It seemed apparent that I was not going to saw my thunder-egg with an 8" saw and the problem required some study.

"I decided to build a 14" saw."

The next day the solution was perfectly clear. I had long dreamed of owning a 10" automatic saw and this was the psychological moment I would build a 10" saw.

Several months later the new saw was completed and it was a dandy. It had a combination spring and friction drive and all kinds of automatic devices so dear to the heart of a gadgeteer like myself. Now, I would make short work of my thunder-egg. At least, so I thought. But I still had a lot to learn about thunder-eggs.

The saw gradually scratched its way through about one-fourth of the thunder-egg accompanied by various and sundry wierd squeaks and squeals which brought forth further comment from the upper regions. But the quality and quantity of these comments was lacking, which showed some improvement, so I kept on sawing until both I and the saw reached a stalemate. The saw stopped and no amount of coaxing would persuade it to operate satisfactorily again. I reset

the blade, changed lubricant, added more tension to the drive and did everything else that I could think of to no avail. It gradually became apparent that the situation was completely out of control and I was not going to saw that thunder-egg with a 10" saw.

This thing was getting complicated and I decided to build a 14" saw.

On the evening of the trial run my friend Mac, complete with rocks, arrived early. We clamped the thunder-egg to the saw table and started the motor. A penetrating mist of kerosene and flushing oil arose from the vicinity of the pump and permeated the atmosphere.

"The pump seems to leak," said Mac. Investigation disclosed that the leak was around the impeller shaft. This was easy. We tightened the pump packing nut and started the motor again. An eighth-inch stream of lubricating mixture squirted out from the edge of the pump and hit me in the eye. Mac calmly appropriated my only shop coat,—apparently it seemed a good idea,—and remarked, "The pump seems to have blown a gasket." I was getting a little impatient. It was doggone obvious that the pump had blown a gasket. Apparently my friend Mac was loaded with under-statements.

We tore the pump down and replaced the gasket, whereupon it leaked in a new place. Mac remarked, "You know, that pump don't seem to work so good," and left to keep an important engagement that he had just remembered, leaving me to clean up the mess.

The next day I discussed the pump situation with my local garage mechanic, who suggested that we discontinue the centrifugal pump located below the tank and substitute an automobile type fuel pump located inside the tank. Then, as he so wisely put it, "if the so-and-so pump wants to leak, let her. She ain't goin-ter get no place in the tank!"

The new pump was installed inside the tank and at the psychological moment Mac appeared complete with his supply of rocks and calmly beat me to my shop coat. After all, judging from past experience one never knew.

The motor was started and there was no corresponding squirt from the pump outlet. "The pump needs priming," said Mac. "The easiest way to prime that kind of a pump is shove a rubber tube in the outlet end and suck." What Mac neglected to say was that the motor should be stopped during that operation. I applied the rubber tube and sucked. Apparently this was the remedy as the pump deposited at least a quart of mixed flushing oil and kerosene in my mouth. I frantically squeezed together the end of the rubber tube which had the effect of a nozzle spraying oil over all of the general vicinity before we could get the motor stopped. Mac said that in his opinion this was a waste of good flushing oil and my wife called down the basement stairs that something smelled bad and whatever we were doing would we please do it elsewhere. She made some reference to the next county.

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BOOKS FOR COLLECTORS AND LAPIDARIES—Gem Trail Journal for your field trips $2.00; Indian Silversmithing, an excellent work for lapidaries, $4.75; Dake's Gem Cutting, $2.00; English's Getting Acquainted With Minerals, $5.00; Dana-Hurlbut's Minerals and How to Study Them, $4.75. Ask for other titles. PAUL VANDEREIKE, Route 2, Box 1168, Vista Calif.

U. S. GEOLOGICAL SURVEY BULLETINS, other publications, back numbers bought and sold. Also files of periodicals. J. S. CANNER & Co., Inc., Boston 19, Mass.

WRITE HENRY L. HIGH, 623-6th Ave., South, Nampa, Idaho, for special prices on good gem material. Many kinds, various colors, sizes. Petrified wood up to 150 lbs. each. Tumbling material. Weiser agate nodules, banded agate, cinnabar agate, red moss jasper. Natural fossil leaves, etc.

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EXCHANGE MINERALS from Franklin, New Jersey. Some fluorescents. Also minerals from New York city. For other minerals, crystals, fluorescents. DANA COLE, 5 Metropolitan Oval, New York 62, N. Y.

The pump was now primed and squirted very energetically, so we opened the hydraulic feed valve and allowed the saw table to slowly approach the saw and the thunder-egg to make contact. "Wump, wump, wump" went the saw and we stopped the motor. Mac allowed as how the arbor hole in the saw was too large and the saw wasn't properly centered on the arbor. It appeared to me that since the hole in the saw was made by the manufacturer whereas the arbor had been turned to fit this hole by Mac, it was just slightly possible that the arbor was too small. Anyway it was easily remedied by a small sheet copper shim around the arbor and once more the motor was started. This time the periphery of the saw blade waved like a bedsheet in the wind and Mac allowed that it seemed to him the saw blade was "kinder out of true." It was by about an inch, but this was corrected by the judicious use of a ball-pean hammer and at last the saw ran perfectly.

Everything was now all ship-shape and proper. Once more the thunder-egg was allowed to approach the saw and make contact and immediately a harsh, raspy and beautiful screech was emitted therefrom. The saw was cutting, boy, how it was cutting!

Mac and I calmly congratulated each other and he removed my shop coat and returned it to me and started unloading rocks from his pockets. I suggested that this occasion called for a celebration and it just happened that I had a gallon of red Italian wine and if he didn't mind a little kerosene—. Mac said that all Italian wine tasted to him like kerosene anyway and he didn't see why a little extra would hurt any,—and besides everything had tasted like kerosene ever since we started working on the so-and-so saw, so he'd take a chance.

We started working on the wine jug and had reached the second glass when there was a klunk from the saw and the screech ceased. At long last I had sawed my thunder-egg.

All my saws are now in operation and doing very fine work as you will find if you visit my lap shop. You have only to step in the basement door, listen to that rumble of moving machinery

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and smell that lovely and unholy smell of kerosene to know that here are saws that are happy, that are co-operative and ever willing to do their share. And the reason for this satisfactory state of affairs is that I have developed an allergy to thunder-eggs. An allergy so powerful that it has given me a sort of radar like intuition which forewarns me the minute a car stops in front of my house and ejects a rockhound complete with thunder-egg and a burning desire to meet a like mortal with a diamond saw. This enables me to dash madly to my shop and put all saws out of commission. My happy and cooperative diamond saws are not allowed to associate with thunder-eggs. Yes sir. To my way of thinking thunder-eggs are a mistake which should never have been allowed to happen.

—L. C. ALDRICH

MIDWEST CLUB NEWS

BERNICE WIENRANK, *Club Editor*
4717 North Winthrop Avenue
Chicago, Illinois

MICHIGAN MINERALOGICAL SOCIETY, the Midwest Federation's 1955 Convention host, has expanded its official publication, *The Conglomerate*, to include convention and other Midwest Federation news. Every member society of the Midwest Federation will be mailed a copy each month.

MMS on September 13 heard Mr. Jerry Wehlann discuss "Techniques Used on Photographing Minerals." Mr. Wehlann's ability in this field was attested to by the showing of his magnificent series of color slides of Mr. John Mihelcic's mineral collection.

WISCONSIN GEOLOGICAL SOCIETY held a fall-round-up meeting on September 8, at which members spoke informally about their summer experiences and exhibited prize rock specimens.

CHICAGO LAPIDARY CLUB members showed signs of uranium-fever after listening to Mr. K. Kincaid Saks discuss "Prospecting for Uranium" at their October 7 meeting and watching him demonstrate several types of Geiger counters.

EARTH SCIENCE CLUB OF NORTHERN ILLINOIS held an exhibit on September 4 of gems, fossils and Indian artifacts in the band room of the Downers Grove High School, as part of Downers Grove's Fall Festival Day.

INDIANA GEOLOGY AND GEM SOCIETY explored May's Cave, Bloomington, Ind., on September 12. Members of the National Speleological Society were on hand to explain the beautiful formations and to guide the group over the "slick" spots. Observing the motto, "Look but leave unmarred," IG&GS members collected on film only.

ST. LOUIS MINERAL AND GEM SOCIETY will have an exhibit of minerals, crystals, gems and fossils, in the main lobby of the St. Louis Public Library during the entire month of November. *Rock Lore* is the descriptive name chosen by SLM&GS for its new bulletin, which is filled with good original articles.

EVANSVILLE LAPIDARY SOCIETY recently viewed "The Arts and Crafts of the Southwest Indians," a color film dealing largely with the silver and turquoise jewelry made by the Navaho, Pueblo and Zuni Indians. The film was obtained through the courtesy of the Santa Fe Railroad.

NEBRASKA MINERAL AND GEM CLUB in November will issue a special "Centennial" issue of its official publication, *The Nebraska Rockhound's Rear Trunk*, to help celebrate the Nebraska Territorial Centennial Year, which is drawing to a close. The special edition will contain articles on geology, paleontology, mineral resources, and rockhounding in Nebraska.

MINNESOTA MINERAL CLUB recently made a trip to Michipicoten Island, in the northeastern part of Lake Superior, where its members picked up some very fine Lake Superior agates and reported seeing an outcrop of vein agate from one to four inches wide and over 20 feet long.

CHICAGO ROCKS AND MINERALS SOCIETY on October 9 heard its president Mr. Addison Avery, lecture on "The Aborigine's Use of Stone and Metal." Mr. Avery, dressed in full Indian regalia, illustrated the talk with examples of Indian weapons, tools, ornaments and ceremonial objects from his extensive collection of Indian artifacts.

NEWS OF OTHER SOCIETIES

WICHITA GEM AND MINERALS SOCIETY recently visited Yates Center, Kansas, site of Kansas' 1879 silver-rush, where the group collected fine-polishing quartzite in red and blue. A Colorado miner viewed outcroppings of this quartzite in 1879 and announced, "There's silver there." As a result, prospectors sank more than 40 shafts in the area, but no silver was found.

HUMBOLDT GEM AND MINERAL SOCIETY'S first Annual Gem and Mineral Fair was a great success, with more than 2,000 people viewing the show.

OKLAHOMA MINERAL AND GEM SOCIETY on September 3 heard Miss Emma Jordan of the House of Winston, speak on the "Biblical History of Gem Stones." Miss Jordan also displayed $500,000 worth of jewelry, including two diamond necklaces valued at $50,000 each; a 12 carat yellow diamond ring; a brooch of white diamonds, centered with a large natural

green diamond; a star ruby; bracelets of diamonds, sapphires and emeralds; pearl rings, and jade earrings.

WASATCH GEM SOCIETY drove to Woodland, Utah, on September 26 for a fun-packed picnic. Many members found good moss agate in the area.

DELVERS GEM AND MINERAL SOCIETY at its September meeting was taken on a tour, via colored slides, of the Silverton, Colorado, mining district. The slides, which were shown and commented on by Marion Speers of the Western Trails Museum, showed abandoned mines and the remains of once bustling towns against a background of lofty mountain peaks.

COLORADO MINERAL SOCIETY made a trip to Gem Village, Colorado, over the Labor Day week end. In nearby McElmo Canyon, the group collected jasperized dinosaur bone, and quartz and chalcopyrite crystals.

RECOMMENDED READINGS

"Living Fossils—The Ginkgo," by Frank Fleener. October issue of *Rock Rustlers News*, Minnesota Mineral Club bulletin, edited by Don Wallace, 1254 Edmund Ave., St. Paul, Minnesota. The oldest living fossil, the Ginkgo tree, survives today only through the reverence and care of man.

"Uranium Flowers May Lead to Ore." August issue of the *Keystone Newsletter*, official publication of the Mineralogical Society of Pennsylvania. Milk vetch, lillies and mustards are among the plants which can tolerate considerable concentrations of uranium and prospectors are learning to look for them when trying to locate uranium-ore deposits.

"Biblical Archaeology," by C. H. T. September issue of *Ozarchaeologist*, official bulletin of the Missouri Archaeological Society, Springfield, Missouri. Caves along the Dead Sea and digs in the Near East are yielding more and more information about the cultures of the peoples mentioned in the Bible.

(A mimeographed address list of publications will be furnished on request by the Club Editor.)

EASTERN FEDERATION CONVENTION

The 1954 Convention and Exhibition of the Eastern Federation of Mineralogical and Lapidary Societies was held at the Biscayne Terrace Hotel and Miami Municipal Auditorium at Miami, Florida, October 12, 13 , 14 and 15.

The 1955 Convention will be held in Washington, D.C., in conjunction with the American Federation Convention, at a date to be determined. J. Lewis Renton, President of the American Federation, of Portland, Oregon,

attended the Convention and was principal speaker at the annual luncheon.

Seventeen dealers exhibited, coming from Alaska, Colorado, Arizona, Georgia, New York, New Jersey and Florida. An area of 2500 square feet was given over to working demonstrations carried on by members of the Miami Mineral and Gem Society, host to the Federation. This area was divided into six sub-areas of 250 square feet each which demonstrated faceting, cabochon making, silver craft slabbing and sawing, and general lapidary work; and one area featured typical individual mineral collections. The jewelry making booth was operated under the auspices of the Lindsey Hopkins Vocational School. Many of the show visitors took advantage of the free instruction at most of these booths and many of them carried away completed gems, jewelry paper weights, etc.

The Show drew an attendance variously estimated at between 35 and 50 thousand persons, with a continuously increasing attendance as the show progressed. Admission was without charge and results proved that a highly specialized show such as this still has great public appeal.

From the standpoint of sales, several well known dealers remarked that it was the best show they had over attended and one remarkable feature of the show was the fact that the tremendous attendance was obtained without the expenditure of a single penny for local publicity. Remarkable cooperation was obtained from the Press, which carried more than 100 column inches of pictures and stories. Television Station WTVJ presented two 15 minute TV programs built around the collection of specimens, the cutting of gems and the making of jewelry, as well as carrying a news telecast showing the Uranium minerals display and the Judges at work.

The Newark Mineralogical Society won the annual trophy for the outstanding Society display, while Albert S. White of Flanders, New Jersey, received the cup for the best individual mineral display and Mrs. Betty Graham of Miami, Florida, the cup for the best display of faceted gems.

Fifteen Societies were represented at the annual meeting which accepted the application of The Boston Mineral Society as the 22nd member of the Eastern Federation.

BACK NUMBERS of Earth Science are still available. Some are in short supply and will soon be gone. If you like Earth Science, you will find much to enjoy in previous issues. All numbers 35 cents each, or 3 for $1. Write Earth Science, Box 1357, Chicago 90, Illinois.

1946

November—Craters of the Moon National Monument, by H. N. Andrews, Jr. An Alaskan Gold Deposit, by Victor Shaw.

1947

January—Natural Steam Plant, by W. D. Keller. Alaska Gold Trails of '98, by Victor Shaw.

February—Michigan Minerals, by Henry P. Zuidema. A Missouri Ebb and Flow Spring, by W. D. Keller.

April—Famous Lost Mines, The Lost Dutchman, by Victor Shaw. Origin of Dolomite, by Kenneth J. Rogers.

May—Famous Lost Mines, The Lost Pegleg Smith, by Victor Shaw. What Camera for the Earth Scientist, by W. D. Keller.

July—Prospecting With a Geiger Counter. Famous Lost Mines, The Lost Dutch Oven, by Victor Shaw. Notes on Crinoid Research, by Harrell L. Strimple.

August—Nebraska's Marsupial Tiger, by H. P. Zuidema. Lake Superior Agate, Part I, by T. C. Vanasse. Famous Lost Mines, The Lost Arch, by Victor Shaw.

November—Zeolites for Lapidaries, by Richard M. Pearl. Famous Lost Mines, The Lost Tub, by Victor Shaw.

December—What Happened to the Dinosaurs, by Russell C. Hussey. Famous Lost Mines, The Lost Papuan, by Victor Shaw.

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January-February—Pollen Grains Write History, by Stanley Cain. Famous Lost Mines, The Lost Gunsight, by Victor Shaw.

April—Sir William Logan, Father of Canadian Geology, Part I, by E. J. Alcock. Geology and the Microscope, Part II, by Jerome Eisenberg.

May—Fire Clay, by W. D. Keller. The Barite Group Minerals, by Richard M. Pearl. Sir William Logan, Part II.

June—Colorado Mineral Localities, by Richard M. Pearl. The American Federation and Earth Science Expansion, by Ben Hur Wilson.

July—Digging for Dinosaurs, by Horace G. Richards. How to Clean Mineral Specimens, by Mary Piper.

September—Forms and Origin of Caves, Part I, by Charles E. Hendrix, Fulgerites, by E. Carl Sink. History of Fossil Collecting, Part II.

October—Forms and Origin of Caves, Part II. Water Witches by W. W. Schidler. History of Fossil Collecting, Part III.

November—Coal Age Flora of Northern Illinois, by Frank L. Fleener. How the Amateur Geologist Can Aid Science, by Gilbert O. Raasch.

December—The Gros Ventre Landslide, Part I, by H. P. Zuidema.

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February—The Moonscar Upon the Earth, Part I, by Harald Kuehn. Staurolite in Georgia, by A. S. Furcron. Bryce Canyon National Park, by Roger L. Spitznas.

March—The Moonscar Upon the Earth, Part II. The Geological Survey, by William E. Wrather.

April—Surface Geology at the Border of an Ice Sheet, by C. W. Wolfe.

May—Coal Geology, by Gilbert H. Cady.

June—The Search for Uranium, Part I, by W. S. Savage. Petroliferous Geodes, by Roger L. Spitznas.

July—Scenic Kansas, by Kenneth K. Landes. The Search for Uranium, Part II.

August—Soil Erosion in Southern Russia, by Wilhelm F. Schmidt. The Search for Uranium, Part III.

September—The Blister Hypothesis and Geological Problems, by C. W. Wolfe. The Green River Oil Shales, by Jerome Eisenberg.

October—Mt. Mazama and Crater Lake, by Jerome Eisenberg.

November—Geophysical Exploration With the Airborne Magnetometer, by Homer Jensen.

December—South Central New Mexico's Sinkholes and Craters, by Alfred M. Perkins.

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January—The Arkansas Diamond Area, by J. R. Thoenen, etc.

February—Archeology and Geology of Northwestern Alaska, by Ralph S. Solecki.

April—Geology by the Mackenzie Delta, Arctic Canada, by Horace G. Richards, Geophysical Exploration, Part II.

May—Teaching Earth Sciences in Secondary Schools, Part I, by Jerome Eisenberg.

June—Geologic History of the District of Columbia, by Martha S. Carr. Teaching Earth Sciences in Secondary Schools, Part II.

July—Atomic Raw Materials, Part I, by Robert J. Wright. A Geologist Visits Europe, by Horace G. Richards. Teaching Earth Sciences in Secondary Schools, Part III.

August—Atomic Raw Materials, Part II. Sedimentation Studies at Lake Mead, by Herbert B. Nichols.

September—Fossil Localities of Northwestern New Mexico, by H. P. Zuidema. Geochemical Prospecting for Ores, Part I, by Jerome Eisenberg.

October—Potential Mineral Resources of Yukon Territory, by H. S. Bostock.

November—Geological Research in Finland, by A. Laitakari.

December—Potholes in the Navajo Sandstone, Zion National Park, by Roger L. Spitznas. The Origin of Sea Water, by Herbert B. Nichols.

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January—Evidence for a Primitive Homogeneous Earth, by Harold C. Urey. New Trilobites Described, by Herbert B. Nichols.

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July—Canon City Panorama, by Richard Pearl. Geological Features of Twin Cities, by George A. Thiel. Chubb Crater, by V. Ben Meen.

September—Studies in Coal, by Frank L. Fleener. Minerals of Eastern Federation, by H. L. Woodruff. Asteriated Gems, by Dr. W. B. S. Thomas.

November—Rattlesnake Butte, by June Zeitner. Meteorites of Xiquipilco, by H. H. Nininger. Studies in Coal, Part 2. Fleener.

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January—Unakite Granite of Virginia, by Dr. Waldo Jones. Famous Lost Mines, the Lost Chinese Rocker, by Victor Shaw. Studies in Coal, Part 3.

March—Atomic Research at Argonne Laboratory, by Robert B. Laraway. Lapidary Topics, Sawing, by William J. Bingham. Silver Islet, by Dr. Frank Fleener.

May—Crown Jewels of England, Dr. J. W. Willems. Into the Dinosaur Country, Wayland W. Magee.

July—Indian Mining and Use of Lead, Dr. H. W. Kuhn; Pothole Erosion, R. L. Spitznas; Symmetries and Asymmetries in Meteor Crater, H. H. Nininger.

September—In Memoriam—Bethel J. Babbitt; Is Boise Sitting on a Volcano, Rhodenbaugh; Worms, Earth Science and Evolution, Burke Smith.

November—Clay Science, Edmond P. Hyatt; Paste-Imitations, J. W. Willems; Rare Fossil Lizards in Kansas, John Watson.

1954

January—Importance of Rhythmic Features, Sauvan; Juvenile Waters, Gaston Burridge; History of Coal, IV, Frank Fleener.

March—Mount Monadnock, Wetherbee; The Great Reptiles, Garrison; Trilobites, Montague.

May—Giant Beavers, Kuhm; Triple Divide Peak, Cooke; Southwest Indian Jewelry, MacFall; Indian Village Locations, Malott.

July—Michigan Minerals, Mihelcic; Cave of Altamire, Dykgraaf-Exner; Bühl Mt. Iron in Basalt, Morely.

September—Kensington Runestone, Denstedt; Idar-Oberstein Restoration, Willems; Death Valley Sagenite, Barnett.

November—Saugus Ironworks, Wilson; Silurian Trilobites, Montague; Bad Lands Chalcedony, Zeitner.